Sedentary work in desk-dominated environments

Impact addendum

"The ultimate impact of a health innovation depends not only on its effectiveness but also on its reach in the population and the extent to which it is implemented with high levels of completeness and fidelity."

(Fernandez et al., 2019)

With the UPcomplish intervention (and related studies as described in this dissertation), we aimed to design, produce, and evaluate an intervention to reduce excessive sedentary behavior - with the ultimate goal to beneficially impact office workers' behavior, health, and, ultimately, their quality of life (Bartholomew et al., 2016). The short answer on the question *"what was the societal impact of this intervention?"* is simple: we only found limited impact *so far* - we did not find sedentary behavior reductions, and even though completeness and fidelity during the intervention period were acceptable and high (100%), respectively, the intervention was (also due to the ineffectiveness) not implemented on a larger scale and might not have reached a population being representative of the target population.

This was not the desired outcome - the UPcomplish intervention was "unsuccessful", and did not manage to reach the impact as defined by Fernandez et al. (2019). However, the intervention did not backfire (i.e. no negative effects) and some impact for specific individuals was found. On another level, participating companies have potentially benefitted from their gained reputation as socially responsible considering the health of their employees as important. This reputation cannot only improve their position on to the market but might also influence their staff members, for instance, concerning job satisfaction and motivation to work.

The studies performed during this project aid several conclusions, lessons learned, and suggestions to increase the potential impact. In sum, we learned that:

1) Sedentary behavior is important, yet not easily changeable.
2) Investments need to be made in terms of the recruitment of amotivated participants.
3) An effective intervention requires the implementation of structural changes.
4) Sedentary behavior needs to be operationalized in a way that it better predicts health.

Sedentary behavior is important, yet not easily changeable.

Diabetes type 2, cardiovascular disease (Biswas et al., 2015; Van Uffelen et al., 2010; Wilmot et al., 2012), and mental health problems (Hamer & Stamatakis, 2014; Voss et al., 2014) are examples of the consequences of sedentary behavior. Therefore, we systematically developed our intervention using Intervention Mapping (see **Chapter 3**). This systematic approach included theory and scientific evidence to optimize potential impact, but it was neither effective in improving sedentary behavior nor quality of life. Our study showed that changing sedentary behavior is not easy: none of the determinants predicting reasoned actions were correlated with changes in sedentary behavior and other psychosocial determinants or underlying beliefs need to be investigated.

Investments need to be made in terms of the recruitment of a-motivated participants.

Another explanation of why we believe our intervention was not successful is rooted in the selectivity of the sample (i.e. highly motivated sample) and in lacking environmental structures facilitating sitting reductions during work and daily life. Post-hoc analyses with a sub-group of participants lower in psychosocial determinants (e.g. perceived behavioral control or

attitude) revealed that improvements in perceived behavioral control was associated with improvements in sedentary behavior. For those people, this could increase short-term well-being, such as perceived vitality and work performance, and reduce the risk for cardiovascular diseases on the long-term. To increase impact, future studies need to find ways to ensure that the intervention is delivered to those who might actually benefit from our intervention.

An effective intervention requires the implementation of structural changes.

Structural changes need to be created to facilitate long-term effectiveness of sedentary behavior interventions. We found that it is realistic to use cheap accelerometers, such as the VitaBit toolkit, that allow for large-scale measurements and tailored coaching despite lower, yet acceptable, validity values. Moreover, personal coaches, in contrast to automated coaching, are still perceived as important. Although personal coaching comes with higher costs, it was possible to create personal and tailored coaching messages helping the coaches to save a substantial amount of time. For instance, without automated messages, we were able to coach a maximum of 15 persons, while with automated messages, hundreds of people could be coached.

Sedentary behavior needs to be operationalized in a way that it better predicts health.

Another way to increase the impact of the tailored coaching as described above is if the health outcome that individual feedback is based on, better aligns with an individual's *actual* health. We found that an algorithm, which incorporates daily sequential physical behavior patterns in one single value was better able to predict health indicators (e.g. body composition) compared to a compositional data approach. The SPORT algorithm (as described in **Chapter 5**) that incorporates sequential physical behavior patterns can be

used to generate individual- and daily-specific sedentary behavior recommendations and, if real-time data are available, to give real-time feedback on physical behavior patterns. Additionally, it is a more accurate predictor for health as compared to traditional approaches that can be applied both in science and in the health sector. Future studies to increase impact should focus on the development and provision of easy calculation tools.

A last structural change that would increase impact is when digital health research and tools are openly shared. Therefore, all data of this dissertation (cleaned and anonymized format), which is the data from the Focus on Strength study (**Chapters 4 & 5**), from the VitaBit validation (**Chapter 2**), from the pre-, and the pilot-study (**Chapter 3**), as well as the data from the effect evaluation and the moderators of effectiveness (**Chapter 6 & 7**) are fully disclosed. We further published or submitted all our manuscripts in open access journal to guarantee transparency and replicability of all our findings. Moreover, the R-script for the tailored coaching messages could easily be adapted to be used for all health behaviors that are measurable and coachable. If we find out, which health behaviors are most relevant for each individual, and they are willing to register the concerning behavior, we could easily increase their health status. This would be the optimal compromise between personal and low-cost, automated coaching, according to the current technical status quo (Summer, 2020).

Conclusion

We systematically developed a workplace intervention to reduce and interrupt sedentary behavior. Although we did not find an overall effect of our intervention, our intervention had some impact for the image of companies, and for the behavior and health of some individuals. With our studies, we highlighted the importance of the field (i.e. sedentary behavior), we cleared the path and suggested focus for future studies, and we started implementing essential structural changes to aid future impact.